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IS 9001-12 (1979): Guidance on Method of Mounting of Electronic and Electrical Items for Dynamic Tests (Redesignation of IS 8456) [LITD 1: Environmental Testing Procedure]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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IS 9001 (Part 12) : 1977
(Redesignating IS:8456-1977)

Indian Standard

GUIDANCE FOR ENVIRONMENTAL TESTING

**PART 12 MOUNTING OF ELECTRONIC AND
ELECTRICAL ITEMS FOR DYNAMIC TESTS**

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NEW DELHI 110 002

Indian Standard

GUIDANCE FOR ENVIRONMENTAL TESTING

PART 12 MOUNTING OF ELECTRONIC AND ELECTRICAL ITEMS FOR DYNAMIC TESTS

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IS 9001 (Part 12) : 1977

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Indian Standard

GUIDANCE FOR ENVIRONMENTAL TESTING

PART 12 MOUNTING OF ELECTRONIC AND ELECTRICAL ITEMS FOR DYNAMIC TESTS

0. FOREWORD

0.1 This Indian Standard was adopted by Indian Standards Institution on 22 April 1977, after the draft finalized by the Environmental Testing Procedures Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 This standard has been largely based on IEC Document 50A (Central Office) 141 ' Draft — Mounting of components, equipment and other articles for dynamic tests, issued by the International Electrotechnical Commission.

0.3 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS: 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard deals with method of mounting of electronic and electrical items for dynamic tests, such as shock, bump, vibration and steady state acceleration.

2. GENERAL

2.1 The method of mounting of electronic and electrical items for dynamic tests shall be specified in the relevant specification. Where these details are not specified, one or more of the standardized methods of mounting given in this standard may be adopted (*see also* Appendix A).

2.1.1 An attempt should be made, in the first instance, to categorise items into either component or equipment types and then to proceed accordingly. If this is not possible, for example, for packages, this standard may still be relevant, but shall be related to the package and not to the contents.

*Rules for rounding off numerical values (*revised*).

2.2 The relevant specification shall state whether the effect of gravitational force is important. If so, the item shall be so mounted that the force acts in the same direction as it would in use. Where the effect of gravitational force is not important, the item may be mounted in any attitude.

2.3 The relevant specification shall state, if significant, the temperature to which the item should not be subjected during the test, for example, as a result of temperature increases in the vicinity of the vibration generator table, and the maximum level of magnetic interference which may be imposed upon it during the functioning of vibration equipment.

3. MOUNTING OF COMPONENTS

3.1 The mounting method to be used shall be stated in the relevant specification.

3.2 Where the method of mounting is not specified but is obvious from the design as in Fig. 1, this method shall be used. Where it is not obvious, the mounting method shall, whenever possible, be chosen in accordance with the principles as shown in Fig. 2, 3 or 4, bearing in mind whether the intention is to load dynamically the leads and/or the body or to determine the internal robustness.

3.3 When the item is to be tested with additional leads attached, these should be so arranged that they impose similar restraint and mass to that when the item is used in its normal manner.

3.4 In all cases, components shall be suitably clamped to a rigid test fixture or directly to the mounting surface of the test apparatus.

NOTE — The term 'clamping' implies an approved method of attaching the component or the component leads to the test fixture. This may be either by soldering, physical clamping between appropriate surfaces or by securing with a suitable adhesive.

4. MOUNTING OF EQUIPMENT AND OTHER ARTICLES

4.1 The item shall be mechanically connected to the mounting surface of the test apparatus either directly or by means of a rigid test fixture, as stated in the relevant specification.

4.2 In cases where the normal mounting structure for the equipment is available, the relevant specification shall state if it shall be used.

4.3 Any additional stays or straps should be avoided. Any connections to the item, such as cables, pipes, etc, should be so arranged that they impose similar restraint and mass to that when the item is installed in its operational position. In order to achieve this, it may be necessary to fasten the cables, pipes, etc, to the fixture.

4.4 Items intended for use with isolators should normally be tested with their isolators. If it is not practicable to carry out the test with the appropriate isolators, the item may be tested without the isolators at a different severity as stated in the relevant specification.

4.5 The relevant specification may require an additional test on an item with the external isolators removed or blocked in order to demonstrate that minimum acceptable structural resistance has been achieved. In this case, the severity to be applied shall be given in the relevant specification.

5. INFORMATION TO BE GIVEN IN THE RELEVANT SPECIFICATION

5.1 When this standard is referred to in a relevant specification, the following details should be given as far as they are applicable:

	<i>Clause</i>
a) Gravitational effect	2.2
b) Maximum and/or minimum temperature	2.3
c) Magnetic interference	2.3
d) Mounting of components	3
e) Mounting of equipment and other articles	4

A P P E N D I X A

(Clause 2.1)

EXPLANATION ON METHODS OF MOUNTING

A-1. COMPONENTS

A-1.1 When the test is to determine the suitability of a component for its operational environment, the relevant specification should ensure that the component is held in a manner which simulates that used in service. It cannot be emphasized too strongly that components above a certain mass, which should be given in the relevant specification, will also require the body being supported both for the test and for the operational environment.

A-1.2 For the method of mounting, the detailed information given in Fig. 1 to 4 should be used. For any special requirements, the manufacturers should be consulted.

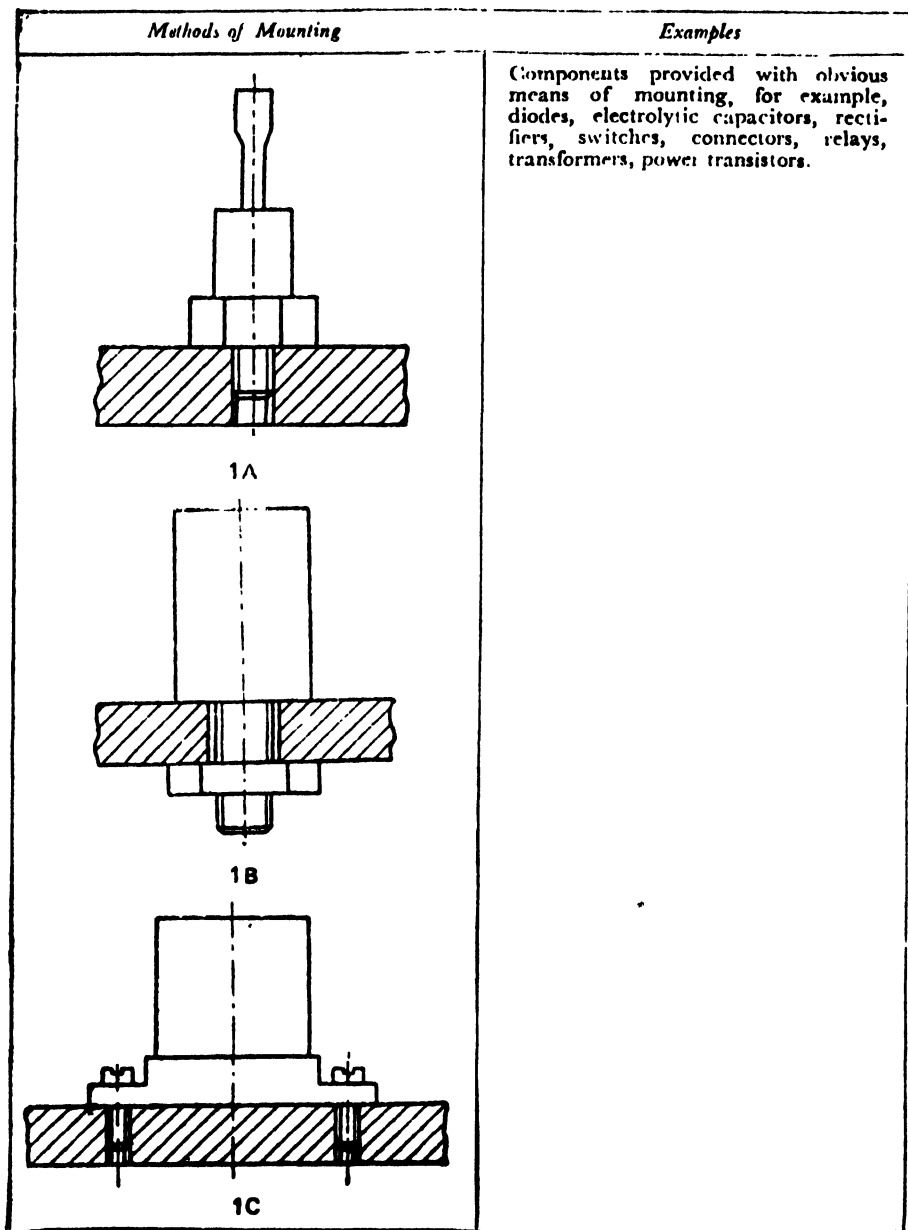


FIG. 1 EXAMPLES OF OBVIOUS MEANS OF MOUNTING COMPONENTS

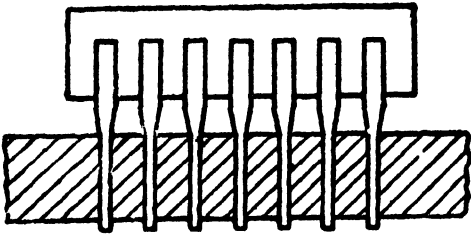
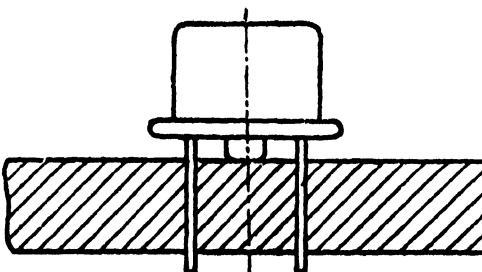
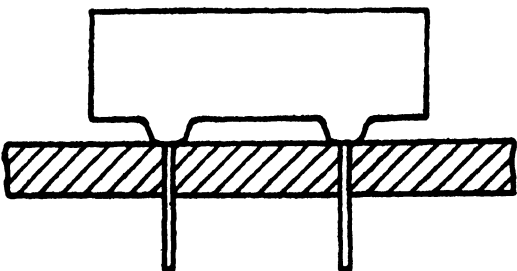
Methods of Mounting	Examples
 2A	Components, such as transistors, integrated circuits, relays and others where the distance to the fixture is limited by design.
 2B	
 2C	Resistors, capacitors.

FIG. 2 EXAMPLES OF MOUNTING OF COMPONENTS BY THE LEADS ONLY — *Continued*

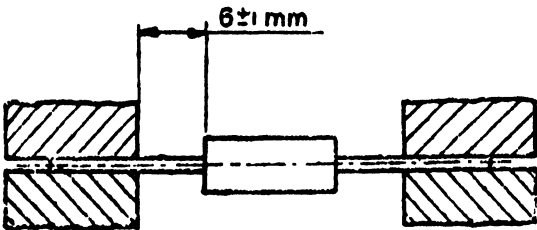
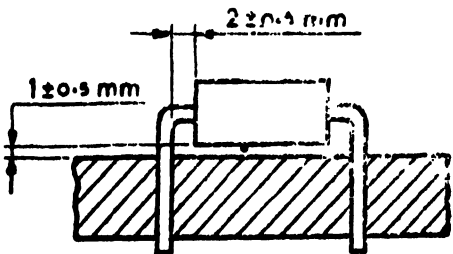
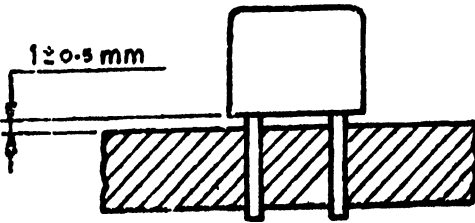
Methods of Mounting	Examples
 2D	Resistors, capacitors, inductors, diodes. NOTE — Applicable for components having a mass not exceeding 6 grains, unless otherwise specified by the relevant specification.
 2E  2F	Resistors, capacitors, inductors, diodes, transistors. NOTE 1 — It is important that the relevant specification states whether or not the component is in contact with the mounting surface. NOTE 2 — Applicable for components whose mass does not exceed 3 grams, unless otherwise specified in the relevant specification.

FIG. 2 EXAMPLES OF MOUNTING OF COMPONENTS BY THE LEADS ONLY

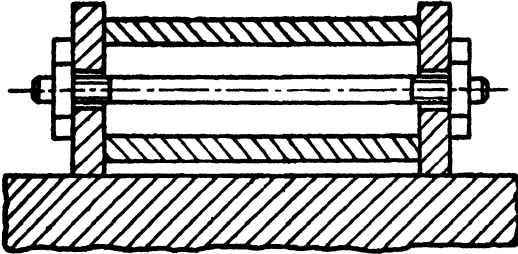
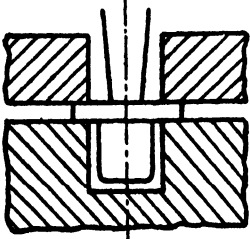
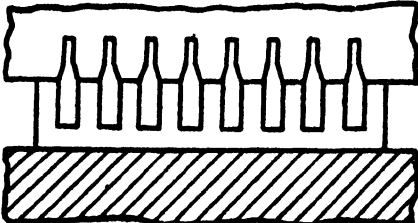
<i>Methods of Mounting</i>	<i>Examples</i>
 3A	Tubular components the coating of which is fragile, such as high power resistors.
 3B	Transistors, diodes.
 3C	Integrated circuits.

FIG. 3 EXAMPLES OF MOUNTING OF COMPONENTS BY THE BODY ONLY

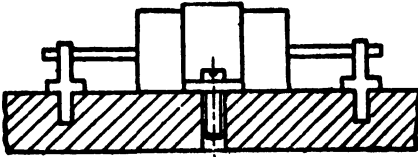
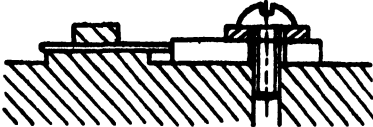
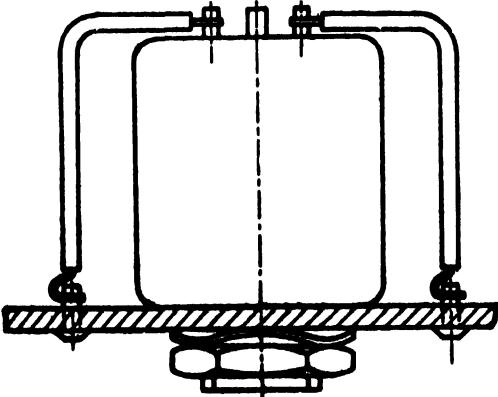
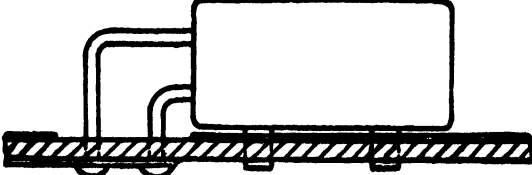
<i>Methods of Mounting</i>	<i>Examples</i>
 4A	Capacitors, relays, additional body fastening, for example, with extra bracket, necessary by reason of mass or severity.
 4B	Transistors mounted on a heat-sink.
 4C	Transformers, chokes.
 4D	Relays

FIG. 4 EXAMPLES OF MOUNTING OF COMPONENTS BY THE BODY AND THE LEADS

A-1.2.1 Some components having special geometrical forms or shapes, for instance, disks, spheres, bulbs, and those requiring special fastening devices are not shown in the figures. For these, it is essential that the relevant specification gives detailed information.

A-1.2.2 If a manufacturer recommends more than one method of mounting, tests should normally be performed using all the appropriate methods. It is recommended that new components are used for each test.

A-1.3 Whichever method is specified or chosen, it is important that components are fastened rigidly to the test fixture or apparatus. This can be achieved by clamping, soldering, embedding or gluing the component body and/or its leads as appropriate.

A-1.3.1 A normal size printed wiring board to which components are fastened does not, generally, give sufficient rigidity, and it may not be possible to achieve the requirements of the test. In addition, reproducibility will probably be impaired. Small portions of a board may prove to be satisfactory, provided that attention is paid to their dynamic characteristics.

A-1.4 When an internal robustness test is to be performed, it is important to note that the mounting method is rarely that which will be used in the operational environment. It is then essential that the dynamic stress be transmitted to the internal structure. It is essential to ensure this by mounting the component by its body and its leads.

A-1.5 When designing test fixtures for high impact or high frequency tests, care should be taken that no resonances exist within the frequency range specified for the test. In addition, it may be necessary for the velocity of sound in the fixture material to be considered. Care should be taken to ensure, as far as is practicable, that the propagation path is well below a quarter wavelength. Test fixtures for large components or for the simultaneous testing of several components will need special consideration and the general principles given for equipment fixtures are applicable (*see A-3*).

A-1.6 Should it be necessary to subject a component to a robustness of terminations test after the dynamic tests, the leads should not be bent for the dynamic tests, nor should they be displaced relative to the body of the component. If, however, this cannot be avoided, the relevant specification should specify that separate components are to be used for the two tests.

A-2. EQUIPMENT AND OTHER ARTICLES

A-2.1 Equipment type items shall be mounted by their normal means of attachment, unless otherwise stated by the relevant specification.

A-2.1.1 It is important that the item is mounted in a manner representative of that used in its operational position. For example, an item normally held by its front panel alone should be so mounted for the test.

A-2.2 In cases where the normal mounting structure is available and it is practicable to use it, it is strongly recommended that this be done, since this is more representative of operating conditions. It should be remembered, however, that the fixing points referred to in the relevant test shall then be taken as those of the mounting structure and not of the item.

A-2.2.1 If the normal mounting structure is not available or, in special cases, where it is known that it does not influence the behaviour of the equipment, the test fixture designed so that the appropriate test requirement can be met, shall be used.

A-2.3 Items intended for use with isolators may sometimes have to be tested without them, for example, if the item is mounted with others in a common mounting system, or if the dynamic characteristics of the isolators are very much variable (for example, if they are temperature dependent). With the exception of the steady state acceleration test, the new level should be determined by considering the envelope of the transmissibility curves of the isolator system along each axis. Where the severity is known to vary with the direction of the applied constraint, this should also be taken into account.

A-2.4 If no transmissibility characteristics are available, the new severity will need to be chosen arbitrarily but preferably after discussion between the supplier and the purchaser.

A-2.5 It should be noted that, for a steady state acceleration test, there may under certain circumstances be a safety hazard if the item is tested with its isolators. The use of stays or straps may then be unavoidable.

A-3. TEST FIXTURES

A-3.1 General

A-3.1.1 The fundamental purpose of the test fixture is to transmit faithfully the constraints from the test apparatus to the item, and to ensure that the specification requirements can be met at the fixing points of the item.

NOTE — A test fixture will invariably be required for mounting and orientation purposes. Therefore, it is considered desirable to highlight possible problem areas associated with the fixture design which could prevent the achievement of the test requirements and thus affect the reproducibility. However, it should be noted that it is not the function of this guidance section to offer solutions; these can be found in the technical literature.

A-3.1.2 The design of the test fixture will be governed by the physical shape and mass of the item, the severity of the test requirements and the capabilities of the test apparatus. These last two parameters are dependent on the test under consideration.

A-3.2 Shock and Bump — The total mass and maximum severity will normally be specified by the manufacturer of the test apparatus. For a given item mass, the design of the test fixture will generally be easier if the capability of the test apparatus is significantly greater than that strictly necessary, since the fixture can then be heavier and less complex.

A-3.2.1 It is still important to consider the effect of stiffness and dimensions (*see* A-3.5).

A-3.3 Vibration — The main parameter limiting the total mass of the item and its test fixture is the thrust capability of the test apparatus. This is normally specified by its manufacturer. In terms of severity, the most important features are the frequency range and displacement and/or acceleration required. However, in terms of the test apparatus performance, large thrust and a wide frequency range are normally incompatible. Thus, unlike the shock and bump situation, it may not be appropriate to use the largest vibration generator available. As a result, test fixtures are normally more complex than those required for other tests and extensive experience is needed in order to achieve satisfactory results. It also needs to be remembered that the frequency response may well be affected when the fixture and item are fastened to the vibration generator.

A-3.3.1 Some of the parameters which need to be considered in the fixture design are given in A-3.5 and A-3.6.

A-3.4 Acceleration, Steady State — The fixture design is simplest for this case, since the acceleration is applied progressively and the dynamic behaviour of the fixture and the item can be ignored. Thus the fixture need only be rigid enough to withstand the static forces involved and sufficiently versatile to accommodate the orientation of the item. It should be remembered, however, that normally a maximum force for the test apparatus will be specified by its manufacturer.

A-3.5 Choice of Material

A-3.5.1 When designing a test fixture, the choice of material will primarily be governed by mass and stiffness considerations. Some problems associated with mass limitations were dealt with as appropriate to each test (*see* A-3.2 to A-3.4). Stiffness, which is only of significance where dynamic considerations are involved, can impose severe restrictions on the design of the fixture.

A-3.5.2 The stiffness of a material is a function of its internal metallurgical and chemical properties. It, therefore, varies over the wide range of metals and plastics available for use. For any given material, the stiffness varies with the dimensions, its means of support (for example, single or double encastered beams) and, to a lesser extent, the method of construction. Certain materials have more advantageous stiffness-to-mass ratios, and this enables a fixture to be stiffer for the same mass, which is often desirable.

A-3.5.3 Another characteristic of a material is its damping, which is also a function of its internal properties. As an example, the internal damping for aluminium is approximately four times greater than that for steel. Damping has some influence, mainly on the behaviour of vibration fixtures. The fundamental aim of the design of the test fixture is to permit no resonances to exist within the frequency range specified for the test. If this is impracticable, then the fidelity of the transmission of vibration from the test apparatus to the item is affected. The degree to which it is affected is directly related to the damping. It should be borne in mind that the damping of most common metals, whilst varying from one to another, has a relatively small effect on the overall behaviour of the test fixture but under certain circumstances it may need to be utilized.

A-3.5.4 A further feature which should be considered, particularly in the case of a shock test requiring a fast rise time or a vibration test with a high upper frequency, is the velocity of sound in the material to be chosen. The propagation path in the material should, wherever practicable, be well below a quarter wavelength.

A-3.5.5 Test fixtures need not be made of the same material throughout. It may be necessary, for various reasons, for example, electrical or thermal insulation, increased damping, to use fixtures made of a combination of materials, such as metal and plastic, or even metal and ceramic.

A-3.6 Method of Construction

A-3.6.1 There are various methods of construction available. These include bolting, riveting, welding, casting, the use of adhesives and, so on. The choice will depend on any difficulties anticipated in meeting the test requirements, the material used, etc. The test fixture should be as simple as possible, for example, a solid block is often all that is necessary. It should be noted that bolted structures will not normally achieve the stiffness obtained with the other forms of construction. This factor becomes important when dealing with large structures and/or high frequencies.

A-3.6.2 All interfaces should be as flat as is necessary to achieve good mechanical contact. In addition, the maximum number of fixing holes on the mounting surface of the test apparatus should be utilized, consistent with the size of the fixture.

A-3.6.3 It is often advantageous to design a fixture which can be used a number of times for different items. If threaded holes are used and the material is such that undue wear might occur, the use of steel inserts is recommended. Care needs to be taken, however, that their fit is adequate and that no deterioration takes place. If bolts are used, they may need to be of the high tensile type.

A-3.6.4 It is important that, when fastening the item to the fixture, no deformation of either should occur. If it does, this probably indicates that the fixture is insufficiently stiff and might prevent the required test severity from being applied to the fixing points of the item.

A-3.6.5 As far as is practicable, all bolts should be tightened to their maximum permitted torque. If damping is likely to be of significance, it should be noted that the internal damping of a bolted or riveted structure is greater than that of one which has been welded.

A-4. BALANCING

A-4.0 Balancing is generally only a problem in the case of vibration and steady state acceleration tests, but may need to be considered for the shock and bump tests.

A-4.1 Vibration — In the case of vibration, it is necessary to ensure that the centre of gravity of the fixture when loaded with the item, which should always be kept as low as possible, is nominally on a line which passes through the centre of gravity of the moving element of the vibration generator and is also perpendicular to the elements surface. In some instances, it may not be possible to ensure that the centre of gravity of the fixture and item is in line with the thrust axis of the vibration generator. This can result in flexure modes, standing wave patterns due to the length of the propagation path and rocking, which restrict the usable frequency range and prevent the test requirements being met at the fixing points of the item. Thus, it may be necessary to use counterbalancing techniques, although these should be avoided unless found to be essential. As the frequency increases, the item, and possibly the fixture, may resonate and, if so, will cause relative movement of the 'dynamic centre of gravity' which will continue to move. This situation can be aggravated if counter balancing techniques have been used. Thus a position is created which currently has no practical solution. This effect can usually be tolerated but, if not, it may be alleviated by the use of a larger or more powerful vibration generator, provided the test specification requirements can still be met.

A-4.1.1 Very often, slip-tables are used in conjunction with vibration generators, in particular where the item is gravity-sensitive and where complex test fixture design might otherwise be necessary. Nonetheless, problems similar to those mentioned above may be encountered.

A-4.2 Acceleration, Steady State — For steady state acceleration testing, a centrifuge is normally used and it is essential to balance the fixture and item statically and dynamically in relation to the test apparatus, in order to prevent damage to its bearings. The manufacturer will normally state the degree of unbalance permissible.

A-5. POSITIONING OF ACCELEROMETERS

A-5.1 The design of the test fixture shall allow for the attachment of accelerometers at the positions required for the appropriate tests. Attachment can be made in a number of ways, usually recommended by the manufacturer of the accelerometer, and include screwing, the use of special adhesives, etc. It may, on occasion, be advantageous in the case of a vibration test to allow for the attachment of additional accelerometers in order to explore the dynamic behaviour of the fixture.

A-6. PERFORMANCE CHECK OF TEST FIXTURE

A-6.1 Before performing a vibration test, it may also be useful to check that the test requirements can be achieved at the specified points when the fixture is either unloaded, loaded with a dynamically-representative item or loaded with the real item. In this latter case, it may be advisable that the check be performed at a lower vibration amplitude than that required subsequently.

A-6.1.1 It may be appropriate to carry out this check in the case of other dynamic tests.

A-7. LARGE AND/OR COMPLEX ITEMS

A-7.1 The terms 'large' and 'complex' are difficult to define. A fixture designed for an item of equipment may be large for a test laboratory normally involved in testing components. This is not the case considered in this standard. 'Large' is intended to describe an item/fixture combination which an equipment testing laboratory would normally have difficulty in handling and which, because of its mass, physical size, complexity of attachment or the frequency range specified, requires a solution which is currently beyond the engineering state of the art.

A-7.2 There are inevitably occasions when such a fixture is required, and it will be found that the test requirements cannot be fully met by conventional means, because the resonance behaviour of the fixture and of the item is beyond control. After having explored other techniques, possibly including the use of parallel operation of vibration generators, reference shall ultimately be made to the test procedure to ascertain what actions need to be taken. Usually the test procedure in such cases requires that the various parameter values achieved are noted and subsequently agreed between the purchaser and the supplier.

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Commercial-cum-Office Complex, Opp. Dushera Maidan, E-5 Arera Colony, Bittan Market, BHOPAL 462016 72 34 52

62/63, Ganga Nagar, Unit VI, BHUBANESWAR 751001 40 36 27

5th Floor, Koval Towers, 44 Bala Sundaram Road, COIMBATORE 641018 21 88 35

Plot No. 58, Neelam Bata Road, NIT, FARIDABAD 121001 542 82 61

Savitri Complex, 116 G.T. Road, GHAZIABAD 201001 471 19 96

53/5 Ward No.29, R.G. Barua Road, 5th By-lane, Apurba Sinha Path, GUWAHATI 781003 54 11 37

5-8-58C, L.N. Gupta Marg, Nampally Station Road, HYDERABAD 500001 320 10 84

E-52, Chitrangan Marg, C- Scheme, JAIPUR 302001 37 38 79

117/418 B, Sarvodaya Nagar, KANPUR 208005 21 68 76

Seth Bhawan, 2nd Floor, Behind Leela Cinema, Naval Kishore Road, LUCKNOW 226001 21 89 23

NIT Building, Second Floor, Gokulpat Market, NAGPUR 440010 52 51 71

Mahabir Bhawan, 1st Floor, Ropar Road, NALAGARH 174101 2 14 51

Patliputra Industrial Estate, PATNA 800013 26 28 08

First Floor, Plot Nos. 657-660, Market Yard, Gultekdi, PUNE 411037 426 86 59

'Sahajanand House' 3rd Floor, Bhaktinagar Circle, 80 Feet Road, RAJKOT 360002 37 82 51

T.C. No. 14/1421, University P. O. Palayam, THIRUVANANTHAPURAM 695034 32 21 04

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